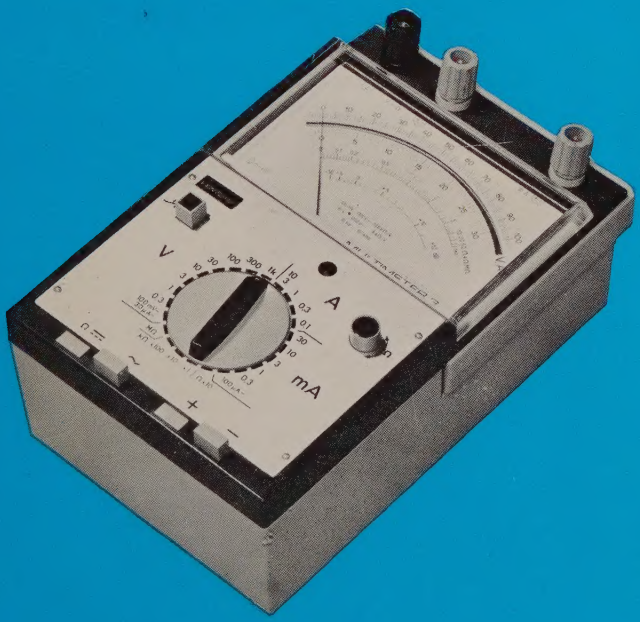
MULTIMETER 3

Racal Medical Ltd.
Test Equipment Maintenance Department
Location:- B2
ID 0219

INSTRUCTION MANUAL



VENTURE MEASUREMENT FOR INDUSTRY

VENTURE MULTIMETER 3

TYPE 226233

INSTRUCTION MANUAL

UH 226233

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INTRODUCTION

The Venture Multimeter 3 is an all-purpose measuring instrument, where particular attention has been paid to easy operation, robustness; both mechanic and electrical, combined with a neat, compact and pleasing appearance.

The Multimeter 3 has many special features such as a sophisticated method of overload protection, which does not rely upon mechanical movement of the pointer and an automatic cut-out which cannot be reset whilst the overload is still connected. The ohms measurement has been simplified by providing only one adjusting control for all five ohms scales, whilst the power requirement is easily met by the single 1.5 cell which is a LPU2 or equivalent (15c - R20, D size, 34mm dia X 61mm leak-resistant).

The problem of changing over connections when measuring semi-conductors, and polarised capacitors, etc. has also been eliminated by the provision of two push buttons which select the polarity of the test supply and movement.

Push button control has been introduced for switching to Ω/dc. or ac. Ac and dc have a common selected range, thus avoiding confusion when measuring ac and dc concurrently. For all measurement only two terminals are used, with the exception of the 10A range which has a separate terminal to indicate that this range is not overload-protected.

The battery, fuse and spare fuses are housed in the rear of the instrument and access to these is easily gained by slackening a captive screw and lifting off the back cover. All the controls, four scales and terminals are clearly coded to avoid any ambiguity. Shunts, multipliers and transformers are available to extend even further the capabilities of the Venture Multimeter 3.

TECHNICAL DATA

Current Ranges

Current		Appr. Voltage Drop	
		⎓	∿
10	A	0.25 V	0.25 V
3	A	0.45 V	0.45 V
1	A	0.3 V	0.3 V
0.3	A	0.3 V	0.3 V
0.1	A	0.25 V	0.25 V
30	mA	0.2 V	0.2 V
10	mA	0.17 V	0.2 V
3	mA	0.17 V	0.1 V
1	mA	0.17 V	0.15 V
0.3	mA	0.17 V	0.3 V
100	µA	0.15 V	–

Voltage Ranges

Voltage	Output	Internal Resistance	
		⎓	∿
1000 V	+50dB	31.6MΩ	5 MΩ
300 V	+40dB	10 MΩ	1.58 MΩ
100 V	+30dB	3.16 MΩ	500 kΩ
30 V	+20dB	1 MΩ	158 kΩ
10 V	+10dB	316 MΩ	50 kΩ
3 V	db scale	100 MΩ	3.16 kΩ
1 V	–10dB	31.6 MΩ	316 Ω
0.3 V	–20dB	10 kΩ	31.66 Ω
100 mV	–	3.16 kΩ	–
0 db equals 0.775V		Ci appr.50pF	Ci appr.50pF

Resistance Ranges

Range	Span	Maximum test current/voltage
Ω x 10	0.2Ω - 500 Ω	13 mA/130 mV
kΩ x 1	20 Ω - 60 kΩ	115 µA/115 mV
kΩ x 10	0.2kΩ- 500 kΩ	15 µA/150 mV
kΩ x 100	2 kΩ- 5 MΩ	15 µA/1.5 V
MΩ	20 kΩ - 50 MΩ	15 µA/ 15 V

Range Expansion

Expanded range	Using	Type
100 A d.c. 50 A d.c. 25 A d.c.	100 mV Shunt Accuracy class 0.5	GE 42 77 GE 42 75 GE 42 73
300 A/3 A a.c. 100 A/1 A a.c. 30 A/0.3 A a.c.	Current transformer (100:1) class 0.2 at 500/5 A, 5 VA Additional reading error with Multimeter 3 less than 0.2% (45...65 Hz)	GE 44 07
600 A/0.3 A a.c. 200 A/0.1 A a.c. 60 A/30 mA a.c. 20 A/10 mA a.c.	Clip-on current transformer (2000:1) Additional reading error with Multimeter 3 less than 3% (45...65 Hz)	GE 44 53
300 A/30 mA a.c. 100 A/10 mA a.c. 30 A/3 mA a.c. 10 A/1 mA a.c.	Clip-on current transformer (10,000:1) Additional reading error with Multimeter 3 less 1% (45...65 Hz)	GE 44 55
1000 A/1 A a.c. 300 A/0.3 A a.c. 100 A/0.1 A a.c.	Clip-on current transformer (10,000:0) Additional reading error with Multimeter 3 less than 1% (54...65 Hz)	GE 44 56
30 kV ⎓ (1000MΩ)	High Voltage Multiplier (test probe)	GE 4196
6 kV ≂ (20MΩ)	High Voltage Multiplier	GE 4157

Accuracy

Limits of Error

With the instrument in a horizontal working condition at a working temperature of 20°C with a sinusoidal a.c. at 45...65Hz.

For voltage and current ranges

Direct current class 1

Alternating current class 2

Resistance ± 1% of scale length

± 4% of true value at mid-scale

± 6% of true value for a span extending from 0.25 to 4 times the value at mid-scale

Frequency Influence

Ranges 0.3V ... 300V) 0.3mA ... 0.3A)	1.5% max. between frequencies of 10Hz and 50kHz
Ranges 3V ... 300V) 3mA ... 0.30)	3% max. between frequencies of 50kHz and 100kHz
Ranges 1000V, 1 and 3A	1.5% max. between 10Hz and 10kHz

Input Capacity (C_i) 50pF approx.

Temperature Influence

Working range -20 and +50°C
For d.c. less than 0.5% of the indicated figure per 10°C
For a.c. less than 0.1% of the full scale deflection per 10°C

External Magnetic Influence

The effect of a d.c. or a.c. field (50 Hz) or 5 Gauss (0.5mT) is negligible.

Waveform Errors

The Instrument is calibrated in r.m.s. values with a form factor of 1.11 for sinusoidal alternating current. The indication produced by the instrument is equivalent to the mean value x 1.11 including non-sinusoidal waveforms. Consequently, a triangular waveform will produce a negative error, whilst a square waveform a positive error.

Errors with superimposed d.c. and a.c. (built in ranges)

The accuracy of the reading is retained as long as the peak value of the a.c. signal does not exceed 1.5 times the maximum of the range selected for the d.c. component and the d.c. signal does not exceed the maximum of the range selected for measuring the a.c. component.

Scales

Mirror backed; length of 110mm (4.3 in)
Voltage Current Ohms and dBs.

Safety - Test Voltage

3000V a.c. in accordance with IEC, VDE, B.S. recommendations. A test voltage of 3000V ensures safe handling of the instrument when measuring voltages of up to 1000V.
Do not handle the instrument when measuring voltages higher than 1000V.

Overload protection

Semi-time lag 4A miniature fuse, 5mm dia x 20mm (M 4 E, DIN 41 571, BS 4265)
Automatic cut-out, maximum rating 2 kW (500 V d.c.), 15 kVa
Surge limiter
Neon discharge lamps and protective diodes.

Battery for resistance measurements

1 monocell 1.5 V, IEC - R 20, D size 34 mm dia. x 61 mm, leak resistant.

Dimensions	205 x 128 x 100 mm (8.1 in x 5 in x 8.3 in)
Weight	Appr. 1.5 kg (3.3 lb) including battery.

Handle (pull-out type)

The handle is slid into the case above the three terminals.

BASIC INFORMATION FOR USERS

General

a) Refer to figure 1 for Instrument Layout. To avoid errors of measurement place the instrument in a horizontal position clear of the effects of iron masses, stray fields (bus-bars), moving-coil instruments, generators and transformers.

b) Check mechanical zero setting with the instrument disconnected.

c) If necessary, clean the scale window, dissipate static electricity by breathing on, or touching the glass or by wiping with a slightly damp cloth.

d) Check that push-button on automatic cut-out is depressed, if it is in the out position it is off. A special interlocking mechanism prevents the resetting of the cut-out while an overload is applied to the instrument. The contact is automatically energised by an overload, d.c. or a.c., and does not require an auxiliary energy source.

e) Set the push-button switch to d.c. "⎓", "+" or "-". a.c. "~" or to "Ω" when measuring the resistance, as required. These switches can be operated during measurement as the measuring circuit is not interrupted.

f) The polarity ("+" or "-") is set by the push-button switch applies to the right-hand terminals. Turn the range selector switch to the desired range. When carrying out current or voltage measurements, start with the highest range and continue to switch down towards the most favourable smaller range, (this does not cause an interuption to the measured circuit). Be sure to observe the range limits.

g) Higher values can only be measured by using separate series resistors (multipliers) and shunts, instrument transformer or clip-on transformers.

h) When connecting the instrument and operating the Ω -adjust control take note of the detailed instructions in the later sections. Abbreviated operating instructions appear on the baseplate. For details of earthing and maximum potentials relative to earth refer to current and voltage measurements.

i) On completion of the measurement, the range switch should always be turned to the highest voltage range. It must not be used as an "OFF" switch, by turning from the 3A range to the 1000V range.

j) The handle is slid into the recess in the case when not in use.

k) Maximum rating: 2 kW/500 V ⎓ 15 kVA.

Overload protection

The instrument is fitted with multiple protection against improper use and overloads. The 10 A range (separate terminal) is not protected.

Automatic cut-out

The relay coils of the cut-out are connected to a selection circuit whose switch is coupled to the range switch. As a result of this arrangement, the sensitivity of the cut-out is at optimum for a given measuring range. When the relay operates the protective switch opens and interrupts the entire measuring circuit.

Protective fuse

WARNING: Disconnect instrument before removing baseplate
A semi-time lag fuse (rated current 4A) protects the instrument in the high current region before the automatic cut-out is triggered and also when a direct short-circuit occurs. It is connected in series with the terminal "$\pm\sim$"
Rating: 250A/250V $\frac{}{\cdots}$: 1000A/250V~
Access to the fuse is by removing the baseplate.

Surge Limiter

A spark gap, connected in parallel with the input terminals, has a flash-over voltage lower than the breakdown voltage of the internal circuit and prevents damage to the instrument due to excessively high voltages (voltage spikes) at low power such as occur, for example, when testing TV receivers, transductors, d.c.-carrying high inductance coils etc.

Neon discharge lamp

The diodes used for rectification when measuring alternating currents are protected by a neon discharge lamp against damage due to voltage peaks.

Protective diodes

Additional protection of the movement is provided by two diodes connected in anti-parallel configuration across the moving coil.

Setting switch positions

CAUTION: do not attempt to measure levels, voltage, current etc. outside those ranges built in to the instrument. Always select higher range value first, reducing the range setting as necessary. For values outside of the instruments maximum ranges refer to those paragraphs within the publication detailing use of Shunts, Multiplier, Transformers.

MEASURING d.c. VOLTAGES UP TO 1000V (Fig.5)

Connect the leads to terminals $\underline{\ }$ and $\pm\sim$ (V.A.Ω).
Select the voltages range required (or work-down from maximum).
Depress the Ω $\frac{}{\cdots}$ button switch.
Depress "+" or "–" button switch.
Indication is on the V.A. scale.
Internal resistance for each range is shown in the technical data.

MEASURING a.c. VOLTAGES UP TO 1000V (Fig.5)

Lead connection as for d.c. voltages
Select the required current range (or work down from the maximum range)
Depress button switch "~"
Depress either button switch + or–
The indication is shown on the V.A. scale
Internal resistance for each range is shown on the technical data.

MEASURING CURRENT (UP TO 3A) (Fig.2)

Lead connection as for d.c. voltages
Select the required current range (or work down from the maximum range)
Depress button switch "~"
Depress either button switch "+" or "–".

MEASURING CURRENTS BETWEEN 3A AND 10A (a.c. and d.c.)(Fig.3)

WARNING: for this test the instrument is not protected.
Transfer the lead from (V A Ω) ⏚ to 10A ⏚ terminal
Select current range "10" / 3
Depress button switch "~"
Depress either button switch "+" or "–".

MEASURING RESISTANCE (connections as Fig.2)

Connect the leads to terminals "⊥" and V.A. "⏚"
Depress button switch "Ω"
Depress either button switch "+" or "–".
Select the required ohm scale.
Open circuit the two 'prods' or clips on the leads.
Rotate the ohms adjust knob "Ω" until the pointer indicates ∞ (infinity).
When the resistance measurement has been completed, set the range selector to one of the high current or high voltage ranges. The battery will discharge if the meter is left with any resistance scale selected. By using the Ω x 10, kΩ x 1, kΩ x 10 ranges, resistors in transistorised circuits can be measured without having to unsolder them, since the test voltage is below the linear-to-exponential transition of the I/V characteristic for transistors and diodes. In assessing the measurement result it is necessary to distinguish between an indication of the value of the resistor under test and one which is affected by a resistance network shunting the resistor under test.
If by mistake, the "~" push-button is depressed while the range selector is on an Ω range neither the full-scale adjustment not a correct resistance measurement will be possible although the pointer will show some deflection. Adjustment is only necessary on changeover between the ranges "kΩ x 1" and "kΩ x 10"; otherwise, the f.s.d. setting remains constant.

For information on changing the battery refer to chapter on Maintenance.

SHUNTS, MULTIPLIERS AND EXTERNAL TRANSFORMER

Where it is required to measure higher voltage which are outside the range of the instrument then a suitable shunt, multiplier or a transformer must be used.

Measuring Current up to 100 A (using shunts) (Fig.4)

Using class 0.5 shunts such as type GE 4277, GE 4275 or GE 4273 connect the shunt across terminals "⊥" and "+ - (VAΩ)". Connect the leads to terminals "⊥" and "+ - (VAΩ)". Select the 100mV switch position. Depress either the "+" or "-" button switches. For a.c. depress button switch "~". For d.c. depress button switch "Ω⎓". The potential should not exceed 1000V. For safety, the shunt should be inserted into the side which has the lowest potential relative to earth.

Measuring Voltages up to 6kV (High voltage Multiplier GE 4157) (Fig.6)

Warning when measuring the high potential (above 1000V) do not touch the meter when the voltage is applied. Use special test cables Zb 09 (test voltage 20KV).
Connect one lead to terminal "⊥".
Connect the external Multiplier in series with the lead terminal to "±~" (VAΩ).
Select the 1K volts range.
Depress either "+" or "-" button switches.
For measuring a.c. depress button switch "~".
For measuring d.c. depress button switch "⎓"
Where possible have terminal "⊥" to the side of the circuit nearest to the earth potential.

Measuring high voltages up to 30kV (Using high voltage Multiplier - test probe GE 4196) (Fig.7)

Using high voltage multiplier (test probe) GE 4196 connect to terminals "⊥" and "±~ (VAΩ)". Earth terminal "⊥" where possible. Select the 30 A range.
Depress push button switches "Ω⎓", "+" or "-".
The indication is shown on scale V.A.
Do not touch the instrument whilst the voltage is applied.

Measuring up to 300A a.c. using external transformer GE 4407 (Fig.8)

Connect the secondary winding to the "⊥" and the "±~" (3A) terminals.
Depending upon the desired range of measurement, the primary conductor carrying the current to be measured should be passed once or several times through the centre hole of the transformer.

The current transformer has been tested for a maximum operating voltage of 650 V. If the operating voltage is higher, neither the instrument nor the connecting wires must be touched.
Set up the range and number of turns as shown in the table below.

Instrument Range	Primary current range with n turns of primary conductor			
	n=1	n=2	n=5	n=10
3 A	300A	150A	60A	30A
1 A	100A	50A	20A	10A
0.3A	30A	15A	6A	3A

Measuring alternating currents and voltages at frequencies up to 100 kHz

In order to preserve the highest accuracy of indication with frequencies up to 100 kHz, connect the "⊥" terminal of the instrument direct to earth, if possible, or to the point with the lowest potential relative to earth. With higher frequencies, the input capacitance of approximately 50 pF causes a reduction of the internal impedance of the instrument.

Measuring alternating currents up to 1000 A, (using clip-on transformers) (Fig.9)

In order to measure alternating currents without interrupting the metered circuit, use clip-on transformers types:

GE 44 53, transformer ratio 2,000:1
GE 44 55, transformer ratio 10,000:1
GE 44 56, transformer ratio 1,000:1

Connect the secondary winding of the clip-on transformer to the "⊥" and the "+~" terminals.
Select the range and scale as detailed in the table below:

Full-scale value (A)		1000	600	300	200	100	60	30	20	10
Range selector	GE 4453	–	0,3A	–	0,1A	–	30mA	–	10mA	–
Setting when using	GE 4455	–	–	30mA	–	30mA	–	3mA	–	1mA
Type	GE 4456	1A	–	0,3A	–	0,3A	–	–	–	–

The additional indication error when using transformer Types GE 44 55 and GE 44 46 is less than +1%, and when using transformer Type GE 44 53 less than ± 3% of f.s.d., provided that there is virtually no air gap between the split cores. Keep the split core faces clean. Clip-on transformers may only be used for operating voltages up to 650V.

MEASURING SUPERIMPOSED d.c. on a.c. (Fig.10)

a) Testing without removing the d.c. component

The internal current transformer makes it possible to measure the d.c. and a.c. components separately. Carry out separate measurements of the two components as has already been described with this band book. If the peak value of the a.c. component does not exceed 1.5 times the maximum value of the range selected for d.c. measurement, the accuracy of the measurement of the d.c. component will not be affected.

Similarly, the accuracy of the measurement of the a.c. component will not be affected if the d.c. component does not exceed the maximum value of the range selected for the a.c. measurement. Consequently, the same measuring range should be selected for both d.c. and a.c. and both components should be measured before changing over to a lower range.

b) Testing with the d.c. component removed

If it is intended to isolate the d.c. component from the instrument when measuring audio-frequency alternating voltages with a superimposed d.c. voltage, connect a suitable capacitor in series with the instrument.

A 1.2μF capacitor, operating voltage 630 V, is recommended.

The employment of this capacitor introduces an additional negative indicating error of 0.2% max. in the 10V range at a frequency $\geqslant$ 50 Hz, and in the 30 ... 300V ranges at a frequency $\geqslant$ 15 Hz. If the capacitor is not to be damaged, its operating voltage must always be higher than the d.c. to be removed.

Carry out the measurement of the a.c. voltage in the manner previously described. Because of the capacitor, which is connected in series with the internal resistance of the instrument, the reading will become frequency-dependent in the lower-frequency region. The higher the frequency and the higher the measuring range, the smaller the additional indicating error shown by the equation:

$$\Delta f\% = \frac{1.25 \times 10^{12}}{f^2 R^2 C^2}$$

Wherein f is the frequency in Hz, R the internal resistance in Ω and C the capacitance in μF and ΔF the additional error as a percentage of the reading.

TESTING DIODES AND TRANSISTORS

The resistance ranges kΩ x 100 and MΩ are suitable for functional tests on diodes and transistors. The following data can easily be ascertained by carrying out a resistance measurement:

Diodes: Forward and reverse direction.
Short or open circuit.
Zener voltage.

Transistors: Short or open circuit between base and collector, base and emitter.
Determining base electrode and transistor type.

The connection from the meter to the component under test need not be reversed because it is possible to change the polarity of the test voltage applied to the terminals by means of the push-button switches (+ -).

Carrying out the test:

Push-button switch: Depress "Ω" push button
Range selector: Set to kΩ x 100
Adjust before testing: In the open-circuit condition adjust to scale mark "30" on the V, A scale (see note).

N.B. For these tests it is adviseable not to adjust the pointer to on the Ω scale (as for resistance measurements) but to gradiate "30" on the 30-division scale. By doing this, the values of reverse current "I_R" and forward voltage "U_F" as well as the zener voltage can be easily calculated. "High value indication" means that the voltage across the component under test is high and the current is small. Conversely, a low voltage indication across the component shows the current in high.

Testing diodes (Range: k x 1000)(Fig.11)

Connection of diode	Indication when depressing push button		Cathode adjacent terminal
	"+"	"-"	± ~
	High	Low	
	Low	High	⊥

The reverse current I_R (high value indication), which flows during testing, can be calculated as follows:

$$I_R = 15 - 0.5 \underline{x}\ (\mu A),$$

$\underline{x}$ being the reading on the V, A : 0-30 scale.
The forward voltage U_F (low value indication) applied to the diode during testing can be calculated as follows:

$$U_F = 50\underline{y}\ (mV),$$

$\underline{y}$ being the indication on the V, A : 0-30 scale.
Typical indications for I_R and U_F are :

for Si-diodes: I_R = 29 ... 30 divisions = 0.5μA
U_F = 9 ... 11 divisions = 0.4 ... 0.55 V
for a current I_F of approx. 10μA.

for GE-diodes I_R = 20 ... 29 divisions = 5.0 ... 0.5μA
U_F = 2 ... 3 divisions = 0.1 ... 0.15 V
for a current I_F of approx. 14μA

If there is only a marginal change or no difference at all between the indications obtained with different polarities, it is safe to assume that there is a defect:
If the reading is 0 or near 0, this points to a short circuit, but if the reading is near f.s.d. it suggests an open circuit. (Approx. 30 on lower VA scale).

Testing Zener diodes (Fig.12)

Determining the cathode (range: kΩ x 100)

Connection of diode	Indication when depressing push button		Cathode adjacent terminal
	"+"	"-"	
	high	low	± ~
	low	high	⊥

During this test, a maximum voltage of 1.5 V is applied to the Zener diode. T_R and U_F can be calculated in the same way as has been described in relation to diodes.

Determining the Zener Voltage

When carrying out this test, set the range selector switch to the MΩ range. Do not adjust the zero in order that the setting at 30 is retained. On this range, a maximum voltage of 15 V is applied to the Zener diode. The Zener diode will not be damaged, as the current is limited to 15μA.
The Zener voltage will be indicated on the instrument when the polarity of the latter is set to produce the higher indications, since U_F is smaller than U_Z. Calculate the Zener voltage as follows:

$$U_Z = \frac{\pm}{2}(V),$$

± being the reading on the VA : 0-30 scale.

Testing transistors (range : kΩ x 100)

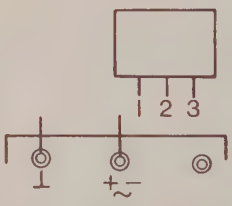
Testing the diode paths

An approximate functional test can be made with regard to the diode paths; base B- emitter E and base B- collector C of the transistor. It should be noted, however, that this test does not show the qualitative behaviour of the component nor the parameters of the transistor type. In particular, the amplification of a transistor cannot be determined.

Determining the base

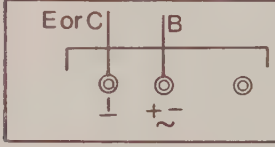
This test resupposes that the diode paths between C-E, B-E and B-C are in tact. This can be determined by testing the diode paths which has already been detailed.

Connect the transistor to the instrument as shown on following page. After carrying out the measurements in both polarities, the base can be found from the following table.

Transistor	Transistor leads to terminal		Indication upon depressing button	The base corresponds to lead
	⊥	+~-	"+" "-"	
	1	2	high *	3
	1	3		2
	2	3		1

Determining the transistor type

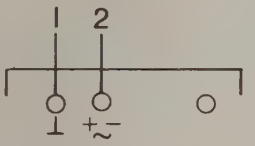
Connect the transistor to the instrument as shown below. After carrying out the measurements using both polarities, the transistor type can be found from the table.

Connection of the Transistor	Indication on depressing button		Transistor type
	"+"	"-"	
	low	high *	npn
	high *	low	pnp

* Approximately full-scale deflection.

Determining the base when the transistor type is known

After connecting up the transistor as shown below, the base can be determined from the table by carrying out the measurement in both polarities.

Transistor	Transistor type	Indication when depressing button		Base corresponds to lead
Connections to instrument	npn	"+"	"-"	
		high[1]	high[1]	3
		low	high	2
		high	low	1
		low[2]	low[2]	short-circuit
	pnp	high	high	3[1]
		low	high	1
		high	low	2
		low[2]	low[2]	short-circuit

1) Approximately full-scale deflection. This test presupposes that the diode paths between C-E, B-E and B-C are intact. This can be determined by testing the diode paths as described in para. 8. 1.

2) Reading near zero. In this case, there is a short between C-E, B-E or B-C.

MAINTENANCE

No special maintenance is necessary for this instrument. It is recommended, however, to check the state of the battery every 6 months at least. A drained or decomposing battery should not be left in the battery compartment. Battery and miniature fuse are easily accessible when the baseplate has been removed.

Warning: Disconnect instrument before removing baseplate!

Ensure that the instrument surface between the terminals remains clean. Heavy soiling impairs the insulation and may reduce the input resistance, especially in relation to the higher voltage ranges. If the instrument has become soiled by dust, liquids etc., clean with dry, soft cloth and, in the case of heavy soiling, with a.water-soaked, damp cloth. The outer surface of the scale window should only be cleaned with a soft, water-soaked cloth and then thoroughly dried.

The inner surface of the scale window should not be cleaned with a cloth or other cleaning agents as the glass on this side is provided with a coating which prevents charging with static electricity which could affect the reading.

SERVICING

Dismantling:

Access to the working parts of the instrument is by removing the rear of the case. This is achieved by removing the back plate which exposes the battery and fuses. Remove the battery. Slacken the four fixing nuts and gently ease the case apart. Some care should be exercised so that the battery connection strips are not damaged: these strips may have to be eased as the case is removed.

Inside the case at the rear is circular cover plate at the end of a spring tensioner which may drop free if the meter is not facing upwards, however no damage will ensue should this happen; simply replace it on top of the spring prior to re-assembly. Each printed circuit can be removed by unsoldering the relevant inter-board connecting wires; undoing the four retaining nuts and lifting off the board and where necessary removing the tubular spacers. The carrying handle can be "sprung-off" if necessary. Maintenance can be carried out on the printed board as required.

When replacing the cover reverse the procedure above but take care not to damage the bonding strip attached to terminal "⊥" which slides easily into the case if positioned correctly.

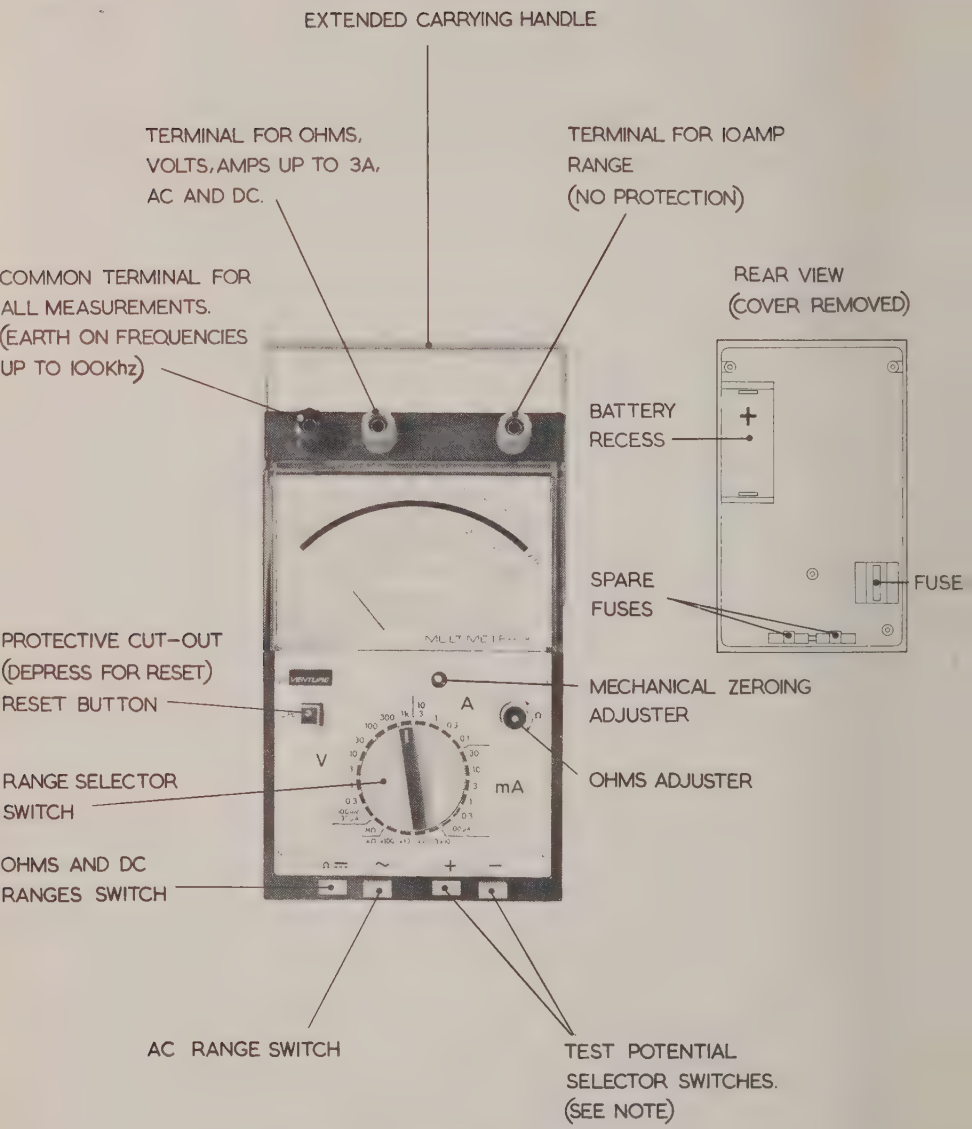
Should it prove necessary to return the Multimeter to the factory for overhaul, it should be sent together with the senders address and details of the fault to.

Service Department, Smiths Industries Limited, Industrial Instruments Division, Waterloo Road, LONDON NW2 7UT. ENGLAND.

The instrument is manufactured in Austria and guaranteed by Smiths Industries Limited, England.

ACCESSORIES AND SPARES

	DESCRIPTION	PART No.	WEIGHT Kg	WEIGHT lb.
100 A d.c.	Shunt, cl. 0.5%, 100mV	GE 42 77	0.1	0.22
50 A d.c.		GE 42 75		
25 A d.c.		GE 42 73		
300-100-30 A a.c.	Current Transformer 100:1 cl. 0.2% at 500/5A and 5VA burden (45 to 65Hz)	GE 44 07	0.35	0.75
500-200-60-20 A a.c.	Clip-on Current Transformer 2,000:1 additional indicating error $\leq$ 3% (45 to 65Hz)	GE 44 53	0.41	0.9
500-100-30-10 A a.c.	Clip-on Current Transformer 10,000:1 additional indicating error $\leq$ 1% (45 to 65Hz)	GE 44 55		
1,000-300-100 A a.c.	Clip-on Current Transformer 1,000:1 additional indicating error $\leq$ 1% (45 to 65Hz)	GE 44 56	1.7	3.7
30kV d.c. (1000 MΩ)	Voltage Multiplier as Test Probe	GE 41 96	0.2	0.45
6kV a.c., d.c. (20 MΩ)	Voltage Multiplier (5kV/25 MΩ)	GE 41 57	0.035	0.08
1 set of leads with plugs, spade terminals, test prods and crocodile clips.		Zb 02	0.11	0.24
1 set of leads with safety plugs at one end, test prods and crocodile clips.		Zb 04[1]	0.13	0.28
Special cable with test prod (test voltage 20kV)		Zb 09	0.09	0.2
Leather carrying case		Zb 467	0.55	1.2
Glass fuse, time lag. (BS 4265) 5 dia. x 20mm for Multimeter 3: - sand filled		M4E		
Leather case for transformer GE 44 56		Zb 338	0.30	0.66


EXTENDED CARRYING HANDLE
TERMINAL FOR OHMS, VOLTS, AMPS UP TO 3A, AC AND DC.
TERMINAL FOR 10AMP RANGE (NO PROTECTION)
COMMON TERMINAL FOR ALL MEASUREMENTS. (EARTH ON FREQUENCIES UP TO 100Khz)
REAR VIEW (COVER REMOVED)
BATTERY RECESS
SPARE FUSES
FUSE
PROTECTIVE CUT-OUT (DEPRESS FOR RESET) RESET BUTTON
MECHANICAL ZEROING ADJUSTER
OHMS ADJUSTER
RANGE SELECTOR SWITCH
OHMS AND DC RANGES SWITCH
AC RANGE SWITCH
TEST POTENTIAL SELECTOR SWITCHES. (SEE NOTE)

N.B. WITH '+' DEPRESSED, CENTRE TERMINAL POSITIVE;

WITH '−' DEPRESSED, CENTRE TERMINAL NEGATIVE;

FIG 1 MULTIMETER 3 TYPE 226233 LAYOUT

FIG 2 CURRENTS UP TO 3A.

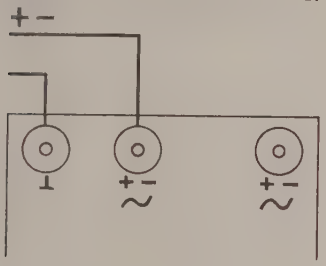


FIG 3 CURRENTS UP TO 10A.

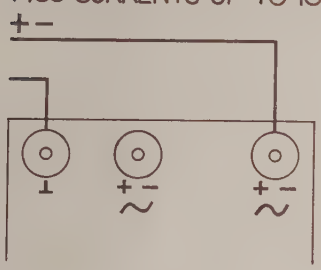


FIG 6 VOLTAGE UP TO 6KV.

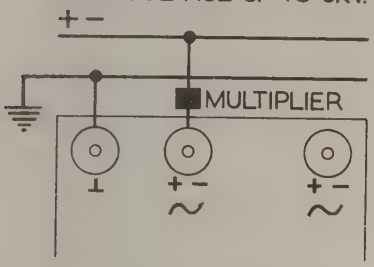


FIG 7 VOLTAGE UP TO 30KV.

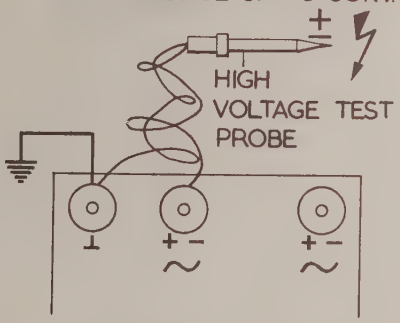


FIG 10 DC SUPERIMPOSED ON AC.

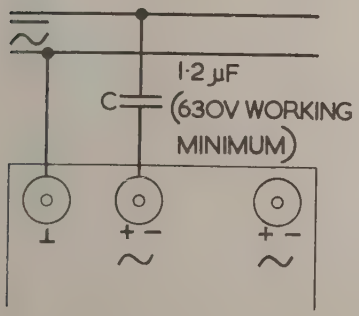


FIG 11 TESTING DIODES

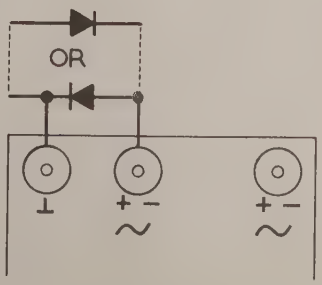


FIG4 CURRENT UP TO 100A.

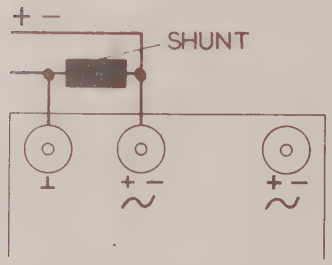


FIG5 VOLTAGE UP TO 1000V.

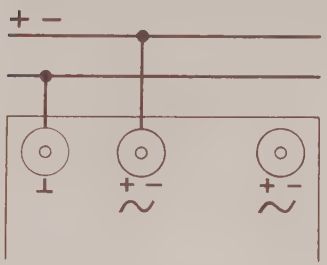


FIG8 MEASURING AC UP TO 300A USING TRANSFORMER GE4407

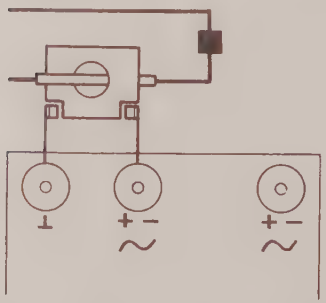


FIG9 MEASURING AC UP TO 1000A USING TRANSFORMERS GE4453 GE4455 OR GE4456

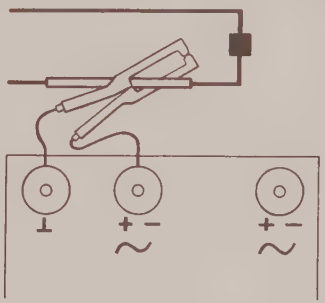


FIG12 TESTING ZENER DIODES

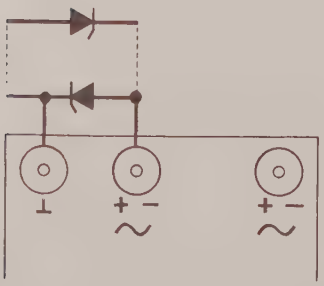
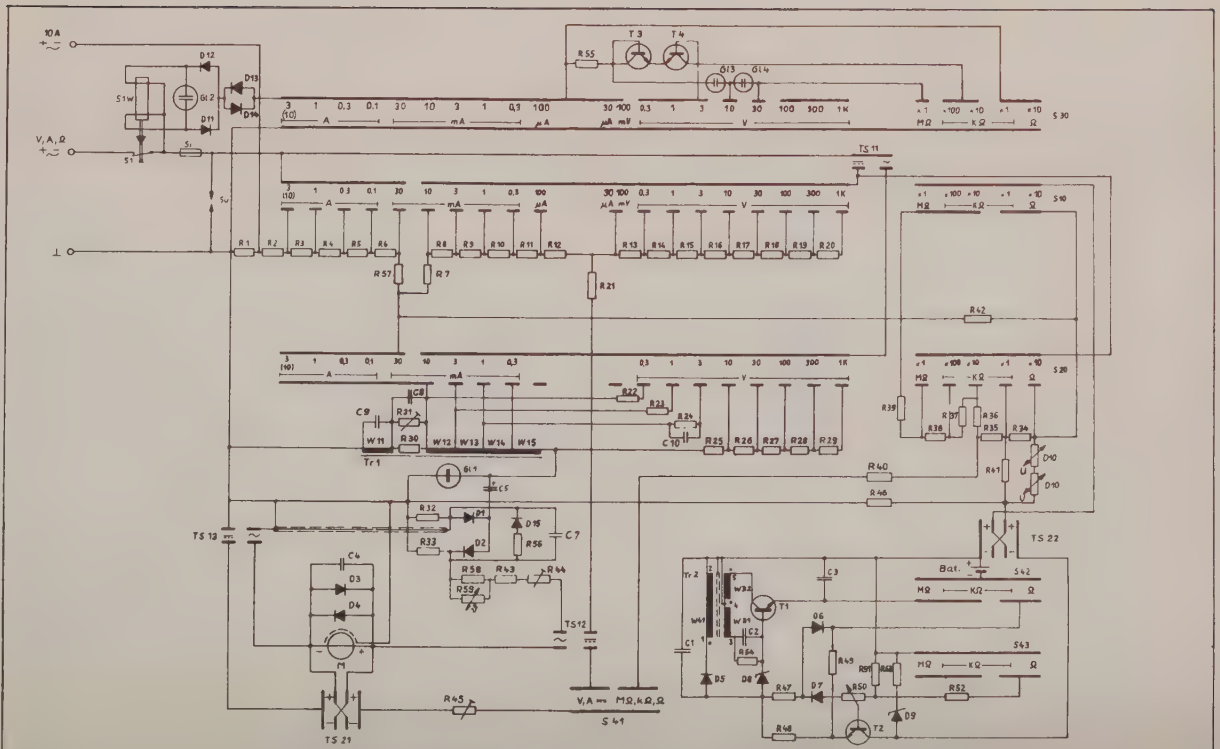


FIG2 TO 12
CONNECTIONS TO
MULTIMETER 3



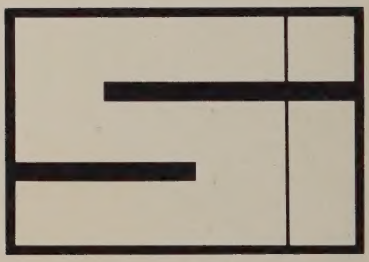
S10...S43 RANGE SELECTOR SWITCH

TS11...TS22 PRESS BUTTON SWITCH

FIG 13 MULTIMETER 3 type 226233 – Circuit

COMPONENTS LIST

R 1	Shunt (Brass)	0.0253 ohms	± 0.2%
R 2	Shunt (Brass)	0.0544 ohms	± 0.2%
R 3	Shunt (Brass)	0.1735 ohms	± 0.2%
R 4	Spool Resistor	0.5486 ohms	± 0.2%
R 5	Spool Resistor	1.730 ohms	± 0.2%
R 6	Spool Resistor	5.486 ohms	± 0.2%
R 7	Spool Resistor	8.7 ohms	± 0.2%
R 8	Spool Resistor	36.74 ohms	± 0.2%
R 9	Carbon Resistor	116.2 ohms	± 0.5%
R10	Carbon Resistor	367.1 ohms	± 0.5%
R11	Carbon Resistor	1.162K ohms	± 0.5%
R12	Carbon Resistor	3.674K ohms	± 0.5%
R13	Carbon Resistor	0.833K ohms	± 0.5%
R14	Carbon Resistor	21.62K ohms	± 0.5%
R15	Carbon Resistor	68.38K ohms	± 0.5%
R16	Carbon Resistor	218.2K ohms	± 0.5%
R17	Carbon Resistor	693.8K ohms	± 0.8%
R18	Carbon Resistor	2.162M ohms	± 0.5%
R19	Carbon Resistor	6.838M ohms	± 0.5%
R20	Double Carbon Resistor	2x10.81M ohms	± 0.5%
R21	Carbon Resistor	6.292K ohms	± 0.5%
R22	Spool Resistor	14.4 ohms	± 0.2%
R23	Carbon Resistor	288 ohms	± 0.5%
R24	Carbon Resistor	3.01K ohms	± 0.5%
R25	Carbon Resistor	48K ohms	± 0.5%
R26	Carbon Resistor	108.1K ohms	± 0.5%
R27	Carbon Resistor	341.9K ohms	± 0.5%
R28	Carbon Resistor	1.081M ohms	± 0.5%
R29	Double Carbon Resistor	2x1.71M ohms	± 0.5%
R30	Spool Resistor	17 ohms	± 0.2%
R31	Potentiometer	500 ohms	± 20% linear
R32	Metal Resistor	1K ohms	± 1%
R33	Metal Resistor	1K ohms	± 1%
R34	Metal Resistor	1.13K ohms	± 1%
R35	Metal Resistor	7.15K ohms	± 1%
R36	Metal Resistor	8.56K ohms	± 1%
R37	Metal Resistor	90K ohms	± 1%
R38	Metal Resistor	903K ohms	± 1%
R39	Carbon Resistor	33K ohms	± 10%
R40	Carbon Resistor	360 ohms	± 5%
R41	Carbon Resistor	200K ohms	± 5%
R42	Spool Resistor	1.55 ohms	± 1%
R43	Carbon Resistor	8K ohms	± 1%
R44	Potentiometer	1K ohms	± 20% linear
R45	Potentiometer	500 ohms	± 20% linear
R46	Double Spool Resistor	2x14 ohms	– 5%
R47	Carbon Resistor	33K ohms	± 2%
R48	Carbon Resistor	68K ohms	± 2%
R49	Carbon Resistor	22 ohms	± 5%
R50	Potentiometer	10K ohms	± 20% linear
R51	Carbon Resistor	680K ohms	± 2%
R52	Carbon Resistor	1.8K ohms	± 5%
R53	Carbon Resistor	15 ohms	± 5%
R54	Carbon Resistor	33K ohms	± 5%
R55	Carbon Resistor	3.3K ohms	± 10%
R56	Carbon Resistor	27K ohms	± 5%
R57	Wire Wound Resistor	0.24 ohms	± 7% WM43 Ø 0.3
R58	Carbon Resistor	1.8K ohms	± 2%
R59	NTC Resistor	4.7K ohms	± 10%
C 1	Ceramic Capacitor	22nF	+ 100% /40 V – 20%
C 2	Ceramic Capacitor	220pF	± 10% /100 V
C 3	Polyester Capacitor	0.47µF	± 10% /100 V
C 4	Ceramic Capacitor	22nF	+ 100% /40 V – 20%
C 5	Tantalum Capacitor	20µF	± 20% /16 V
C 7	Ceramic Capacitor	22nF	+ 100% /40 V –20%
C 8	Polyester Capacitor	51nF	± 5% /400 V
C 9	Polystyrene Capacitor	9.1nF	± 2.5% /160 V
C10	Ceramic Capacitor	82pF	± 10% /1000 V
D 1	Germanium diode	OF 325	
D 2	Germanium diode	OF 325	
D 3	Silicon diode	IN 4148 or IN 914	
D 4	Silicon diode	IN 4148 or IN 914	
D 5	Silicon diode	IN 4148 or IN 914	
D 6	Silicon diode	IN 4148 or IN 914	
D 7	Silicon diode	IN 4148 or IN 914	
D 8	Zener diode	BZX 79 B 22	
D 9	Zener diode	BZX 79 C 24	
D10	2 Varistor	V75	
D11	Silicon diode	IN 4002	
D12	Silicon diode	IN 4002	
D13	Silicon diode	IN 4002	
D14	Silicon diode	IN 4002	
D15	Germanium diode	OF 325	
T 1	Npn-Silicon transistor	BC 168 C	
T 2	Npn-Silicon transistor	BC 168 C	
T 3	Npn-Silicon transistor	BC 168 C	
T 4	Npn-Silicon transistor	BC 168 C	



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